Marine Physical Laboratory

VAST and MDA-1 Experiment Support and Data Analysis

William S. Hodgkiss

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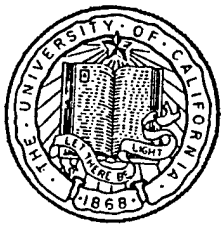

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The Marine Physical Laboratory (MPL) provided experiment support and data analysis for the VAST and MDA-1 experiments. MPL participated in all three of the experiments carried out by the High Gain Initiative (HGI) Program. MPL was involved in all aspects of these experiments including experiment planning, participation in the experiments, data distribution, experiment data quick-look analysis, array element localization, and ambient noise analysis. MPL also applied its engineering experience with the design, fabrication, and deployment of the SVLA and VAST arrays during design reviews of a major array acquisition by the Office of Naval Technology.

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Abstract

The Marine Physical Laboratory (MPL) provided experiment support and data analysis for the VAST and MDA-1 experiments. MPL participated in all three of the experiments carried out by the High Gain Initiative (HGI) Program. MPL was involved in all aspects of these experiments including experiment planning, participation in the experiments, data distribution, experiment data quick-look analysis, array element localization, and ambient noise analysis. MPL also applied its engineering experience with the design, fabrication, and deployment of the SVLA and VAST arrays during design reviews of a major array acquisition by the Office of Naval Technology.

Research Objective

The objective of this work was to provide experiment support and data analysis for the VAST and MDA-1 experiments.

Research Summary

The Marine Physical Laboratory (MPL) participated in all three of the experiments carried out by the High Gain Initiative (HGI) Program: (1) SVLA (September 1987), (2) VAST (July 1989), and (3) MDA-1 (July 1991). The first two took place in the NE Pacific and the third took place in the NW Atlantic. The work covered here was in support of both VAST and MDA-1.

MPL was involved in all aspects of these experiments including experiment planning, participation in the experiments, data distribution, experiment data quick-look analysis, array element localization, and ambient noise analysis. MPL also applied its engineering experience with the design, fabrication, and deployment of the SVLA and VAST arrays during design reviews of a major array acquisition by the Office of Naval Technology.

As noted, MPL was heavily involved in the planning, carrying out, and quick-look analysis of the VAST and MDA-1 experiments. Reports and memorandums related to these activities include [1-8].

One of the major contributions of MPL to the HGI Program was in the area of array element localization (AEL). The desire to know array hydrophone positions to within a few meters accuracy motivated the use of acoustic AEL in all three of the HGI experiments. Due to the apertures of the arrays involved in the experiments, it was known that the arrays could not be assumed straight and that their shapes would evolve over time due to wind, current, and tidal influences. Thus, it was important to develop the capability of navigating the time-evolving element positions in three-dimensional space.

The general approach was the same in each experiment. A transponder net was placed around the array near the seafloor then surveyed in with the help of a support ship. During the experiment, the transponder net was interrogated and the 12 kHz replies detected by navigation receivers embedded in the array. The round-trip travel time of the interrogating pulse and the detected arrival times of the 12 kHz replies are used to localize the navigation receivers in (x,y,z) coordinates.

In the first two HGI experiments (SVLA and VAST), vertical arrays were deployed from the R/P FLIP. Wind and surface current forces acting on FLIP resulted in array excursions of 50-100 m over periods of several hours. In contrast, the submerged tripod array deployed during the MDA-

1 experiment exhibited motions of on the order of 5 m over similar time periods. Reports documenting AEL-related analysis of the VAST and MDA-1 experiments include [9-12].

A second major area where MPL contributed to the HGI Program was in the short-term analysis of ambient noise. Short-term noise statistics refers to statistical characterizations over time intervals in which a single detection decision might be made. These typically would be periods from a few minutes to a few tens of minutes.

The objectives of the noise analysis were twofold. First, the desire was to ascertain the interval over which the time series at the output of individual hydrophones, conventional beams, and matched-field processor ambiguity cells are stationary. Second, for those periods when the time series can be considered stationary, the desire was to determine if the time series also can be considered Gaussian.

In general, the results of these analyses show that ambient noise during MDA-1 can be considered stationary for periods of 1/2 hour and Gaussian at the hydrophone, conventional beam, and matched-field ambiguity cell level. Furthermore, when non-stationarity or non-Gaussian character was observed, it usually could be related to spatially isolated sources of energy. Memorandums documenting the ambient noise analysis include [13-14].

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